

PART-I : PHYSICS

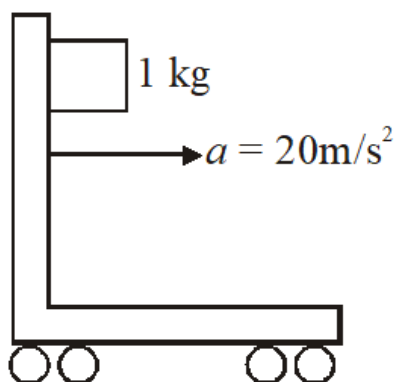
1) A projectile has the same range R for two angles of projection. If T_1 and T_2 be the times of flight in the two cases, then R is

- (1) $T_1 T_2 g$
- (2) $\frac{T_1 T_2 g}{2}$
- (3) $(T_1^2 + T_2^2) g$
- (4) $\frac{(T_1^2 + T_2^2)}{2} g$

2) A very broad elevator is going up vertically with a constant acceleration of 2 m/s^2 . At the instant when its velocity is 4 m/s a ball is projected from the floor of the lift with a speed of 4 m/s relative to the floor at an elevation of 30° . The time taken by the ball to return the floor is ($g = 10 \text{ m/s}^2$)

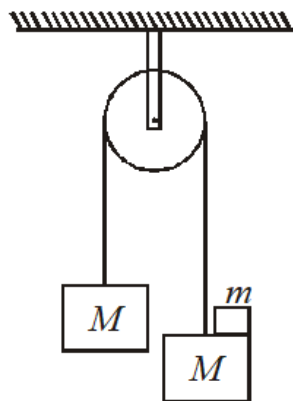
- (1) $\frac{1}{2} \text{ s}$
- (2) $\frac{1}{3} \text{ s}$
- (3) $\frac{1}{4} \text{ s}$
- (4) 1 s

3) A block of mass 1 kg just remains in equilibrium with the vertical wall of a cart accelerating uniformly with 20 m/s^2 as shown. The co-efficient of friction between block and wall is ($g = 10 \text{ m/s}^2$)



- (1) 0.1
- (2) 0.2
- (3) 0.5
- (4) 1

4) Two identical blocks of mass M are linked by a thread wrapped around a pulley-block with a fixed axis. A small block of mass m is placed on one of the blocks as shown. If pulley and strings are ideal,



the force exerted by small block m on block M is,

- (1) $\frac{mMg}{2M + m}$
- (2) $\frac{2mMg}{2M + m}$
- (3) $\frac{2mMg}{M + m}$
- (4) $\frac{2m^2g}{2M + m}$

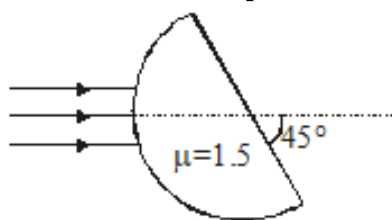
5) If photons of energy 12.75 eV are passing through hydrogen gas in ground state then no. of lines in emission spectrum will be.

- (1) 6
- (2) 4
- (3) 3
- (4) 2

6) If α and β are the current gain in the CB and CE configurations respectively of the transistor circuit, then $\frac{\beta - \alpha}{\alpha\beta}$ is equal to

- (1) ∞
- (2) 1
- (3) 2
- (4) 0.5

7) A parallel narrow beam of light is incident on the surface of a transparent hemisphere of radius R and refractive index $\mu = 1.5$ as shown. The position of the image formed by refraction at the



spherical surface only is

- (1) $\frac{R}{2}$

(2) $3R$

(3) $\frac{R}{3}$

(4) 2

8) When a thin transparent sheet of refractive index $\mu = \frac{3}{2}$ is placed near one of the slits in Young's double slits experiment, the intensity at the centre of the screen reduces to half of the maximum intensity. The minimum thickness of the sheet should be

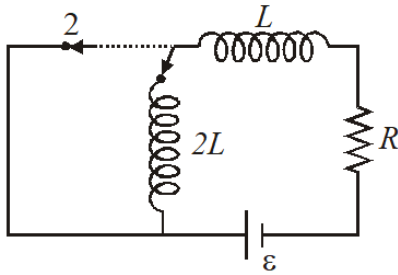
(1) $\frac{v}{\lambda}$

(2) $\frac{\lambda}{8}$

(3) $\frac{\lambda}{2}$

(4) $\frac{\lambda}{3}$

9) In the circuit shown switch is connected to 1 for a very long time. At a particular instant $t = 0$, switch is shifted to 2, the current in the circuit after a time gap of $\frac{L}{R}$ is



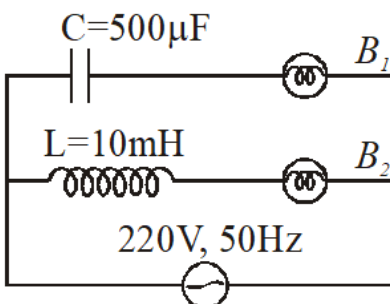
(1) $\frac{\varepsilon}{2R}$

(2) $\frac{3\varepsilon}{R}$

(3) $\frac{3\varepsilon}{Re}$

(4) $\frac{\varepsilon}{R}$

10) In the circuit shown in the figure, if both the bulbs B_1 and B_2 are identical, then



(1) Their brightness will be the same

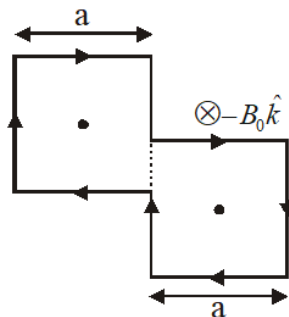
- (2) As frequency of supply voltage is increased, brightness of B_1 will decrease and that of B_2 will increase
- (3) As frequency of supply voltage is increased, brightness of B_1 will increase and that of B_2 will decrease
- (4) Only B_2 will glow because the capacitor has infinite impedance

11) When a 4 kg mass is hung vertically on a light spring that obeys Hook's law, the spring stretches by 2 cm. The work required to be done by an external agent in stretching this spring further 5cm will be ($g = 9.8 \text{ m/s}^2$)

- (1) 0.245 J
- (2) 4.410 J
- (3) 2.450 J
- (4) 4.900 J

12) A heavy uniform chain lies on a horizontal table-top. If the co-efficient of friction between the chain and table surface is 0.25, then the maximum fraction of length of the chain, that can hang over one edge of the table is

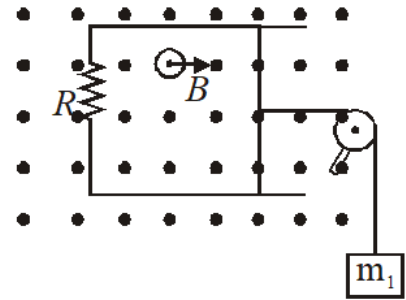
- (1) 20%
- (2) 25%
- (3) 35%
- (4) 15%



13) The torque acting on this loop will be

- (1) Zero
- (2) $\frac{la^2 B_0}{2}$
- (3) $\frac{2la^2 B_0}{3}$
- (4) None

14) A rod of length l , negligible resistance and mass m slides on two horizontal frictionless rails of negligible resistance by hanging a block of mass m_1 by the help of insulating massless string passing through fixed massless pulley (as shown). If a constant magnetic field B acts upwards perpendicular



to the plane of the figure, the terminal velocity of hanging mass is

- (1) $\frac{m_1 g R}{B^2 l^2}$ upward
- (2) $\frac{m_1 g R}{B^2 l^2}$ downward
- (3) $\frac{m_1 g R}{2 B^2 l^2}$ downward
- (4) $\frac{m_1 g R}{B^2 l}$ downward

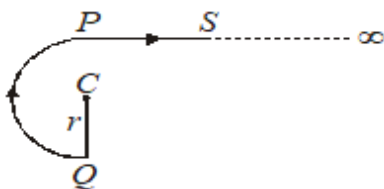
15) A ball is dropped from a height h . It rebounds from the ground a number of times. Given that the coefficient of restitution is e , to what height does it go after n th rebounding?

- (1) h/e^n
- (2) h/e^{2n}
- (3) he^n
- (4) he^{2e}

16) Which of the following is true?

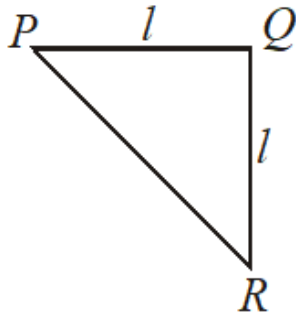
- (1) Diamagnetism is temperature dependent
- (2) Paramagnetism is temperature dependent
- (3) Paramagnetism is temperature independent
- (4) None of the above

17) The magnetic induction field at the centre C of the arrangement shown in figure is



- (1) $\frac{\mu_0 i}{4 \pi r} (1 + \pi)$
- (2) $\frac{\mu_0 i}{2 \pi r} (1 + \pi)$
- (3) $\frac{\mu_0 i}{2 \pi r} (1 + \pi)$
- (4) $\frac{\mu_0 i}{r} (1 + \pi)$

18) In the triangular sheet shown, $PQ = QR = l$. If M is the mass of the sheet, its moment of inertia



about PR is

- (1) $\frac{Ml^2}{24}$
- (2) $\frac{Ml^2}{12}$
- (3) $\frac{Ml^2}{6}$
- (4) $\frac{Ml^2}{18}$

19) The centre of a wheel rolling on a plane surface moves with a speed v_0 . A particle on the rim of the wheel at the same level as that centre will be moving at speed

- (1) Zero
- (2) v_0
- (3) $\sqrt{2}v_0$
- (4) $2v_0$

20) From a uniform circular plate of radius R , a small circular plate of radius $R/4$ is cut off as shown. If O is the center of the complete plate, then the distance of the new center of mass of the remaining

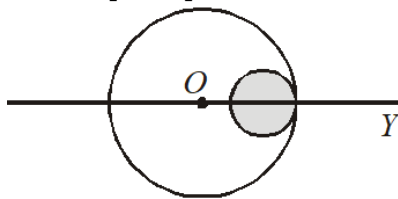
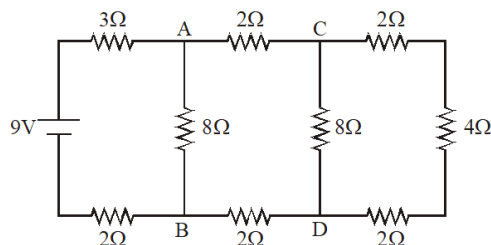


plate from O will be

- (1) $-\frac{R}{20}$
- (2) $-\frac{R}{16}$
- (3) $-\frac{R}{15}$
- (4) $-\frac{3}{4}R$

21) In the circuit shown in figure, the current through



- (1) The $3\ \Omega$ resistor is $0.50\ \text{A}$
- (2) The $3\ \Omega$ resistor is $0.25\ \text{A}$
- (3) The $4\ \Omega$ resistor is $0.50\ \text{A}$
- (4) The $4\ \Omega$ resistor is $0.25\ \text{A}$

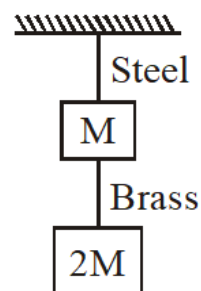
22) If a body is to be projected vertically upwards from earth's surface to reach a height of $10R$ from surface of earth, (where R is the radius of earth), the velocity required to do so is

- (1) $\sqrt{\left(\frac{24}{11}gR\right)}$
- (2) $\sqrt{\left(\frac{22}{11}gR\right)}$
- (3) $\sqrt{\left(\frac{20}{11}gR\right)}$
- (4) $\sqrt{\left(\frac{18}{11}gR\right)}$

23) The distances from the centre of the earth where the weights of the body is zero and one fourth that of the weight of body on the surface of earth are respectively (Assume R is the radius of the earth)

- (1) $0, \frac{R}{4}$
- (2) $0, \frac{3R}{4}$
- (3) $\frac{R}{4}, 0$
- (4) $\frac{3R}{4}, 0$

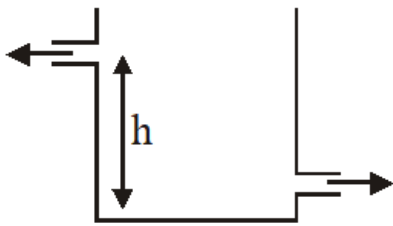
24) If the ratio of lengths, radii and Young's modulus of steel and brass wires in the figure are a, b



and c respectively, then the corresponding ratio of increase in their lengths would be

- (1) $\frac{2a^2c}{b}$
 (2) $\frac{3a}{2b^2c}$
 (3) $\frac{2ac}{b^2}$
 (4) $\frac{3c}{2ab^2}$

25) There are two identical small holes on the opposite sides of a tank containing a liquid. The tank is open at the top. The difference in height between the two holes is h . As the liquid comes out of the two holes, the tank will experience a net horizontal force proportional to

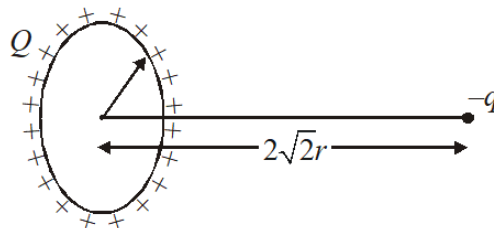


- (1) $\sqrt{h}$
 (2) h
 (3) $h^{3/2}$
 (4) h^2

26) A cube of side b has a charge q at each of its vertices. The electric potential at the centre of the cube is

- (1) $\frac{4q}{\sqrt{3}\pi\epsilon_0 b}$
 (2) $\frac{\sqrt{3}q}{\pi\epsilon_0 b}$
 (3) $\frac{2q}{\pi\epsilon_0 b}$
 (4) Zero

27) A charge $-q$ is placed at the axis of a charged ring of radius r at a distance of as shown in figure. If ring is fixed and carrying a charge Q , the kinetic energy of charge $-q$ when it is released and



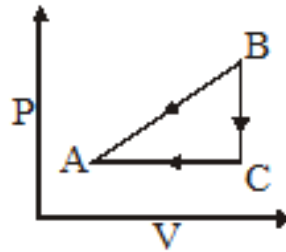
reaches the centre of ring will be,

- (1) $\frac{qQ}{4\pi\epsilon_0 r}$

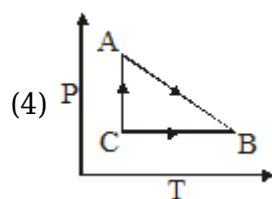
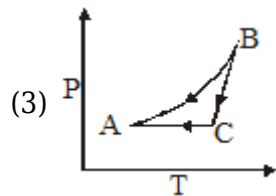
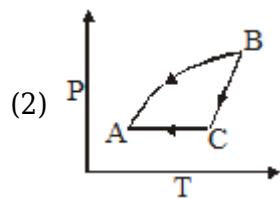
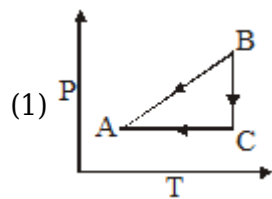
(2) $\frac{qQ}{12\pi\epsilon_0 r}$

(3) $\frac{qQ}{6\pi\epsilon_0 r}$

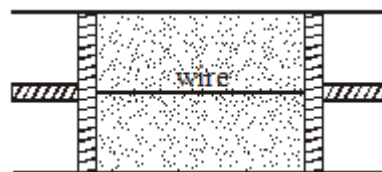
(4) $\frac{qQ}{2\pi\epsilon_0 r}$



28) P-T curve of the following process will be



29) A cylindrical tube of uniform cross-sectional area A is fitted with two air tight frictionless pistons. The pistons are connected to each other by a metallic wire. Initially the pressure of the gas is P_0 and temperature is T_0 . Atmospheric pressure is also P_0 . Now the temperature of the gas is



increased to $2T$, the tension in the wire will be.

(1) $2P_0A$

(2) P_0A

- (3) $\frac{P_0 A}{2}$
 (4) $4P_0 A$

30) The power of sound from the speaker of a radio is 20 mW. By turning the knob of volume control the power of sound is increased to 400 mW. The power increase in dB as compared to the original power is ($\log_{10} 2 = 0.3$)

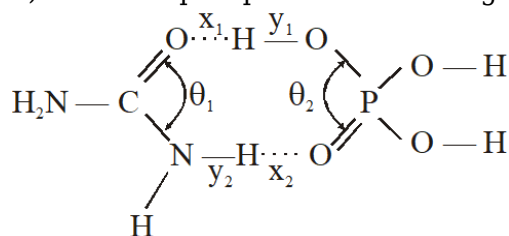
- (1) 1.3 dB
 (2) 3.1 dB
 (3) 13 dB
 (4) 30.1 dB

PART-II : CHEMISTRY

1) Which of the following represent correct order of hydration energy released in aqueous state :

- (1) $N^{-3} > O^{-2} > F \cdot \cdot$
 (2) $F \cdot \cdot < Cl \cdot \cdot < Br \cdot \cdot < I \cdot \cdot$
 (3) $Li^+ < K^+ < Cs^+$
 (4) $Al^{+3} > Mg^{+2} > Na^+$

2) Urea and phosphoric acid undergo H-bonding in the following manner :-



x_1, x_2 are H-bond length

y_1, y_2 are covalent bond length

Select the only **INCORRECT** option

- (1) $x_1 < x_2$
 (2) $y_2 < y_1$
 (3) $\theta_1 \simeq \theta_2$
 (4) Number of $p\pi - d\pi$ bonds present in the diagram is one

3) Which of the following order is **CORRECT** for boiling point ?

- (1) $NH_3 > PH_3$
 (2) $CH_3 - O - CH_3 > C_2H_5OH$
 (3) o-hydroxybenzaldehyde > m hydroxybenzaldehyde
 (4) None of these

4) Which ions of lanthanides have completely filled 'N' shell

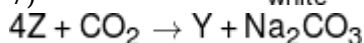
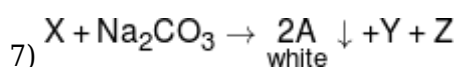
- (1) La^{3+} , Ce^{+4}
- (2) Lu^{3+} , Yb^{2+}
- (3) Gd^{3+} , Tb^{3+}
- (4) La^{3+} , Lu^{3+}

5) Select the **correct** statement out of following -

- (1) NO_3^- gives brown ring test in presence of dil. H_2SO_4
- (2) During chromyl chloride test change in oxidation state of chromium takes place
- (3) On passing H_2S gas into aqueous solution of SO_2 gas clear solution is produced
- (4) Alkaline solution of K_2HgI_4 is known as Nessler's reagent

6) In the electrolysis of alumina which is **INCORRECT** statement

- (1) Powdered coke is spreaded on the surface of the electrolyte to prevent reduction of graphite anode
- (2) Na_3AlF_6 and CaF_2 are used to decrease M.P. and increase conductivity
- (3) In electrolysis of alumina both CO and CO_2 evolve
- (4) Na_3AlF_6 and CaF_2 act as co-electrolyte



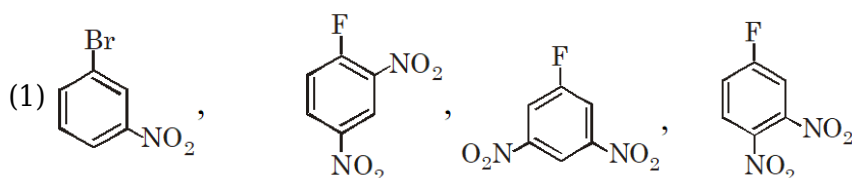
In above reaction Y is :

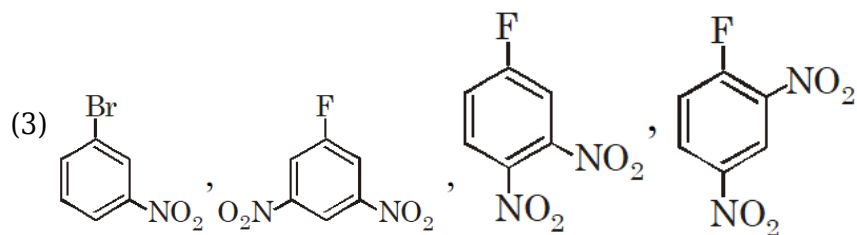
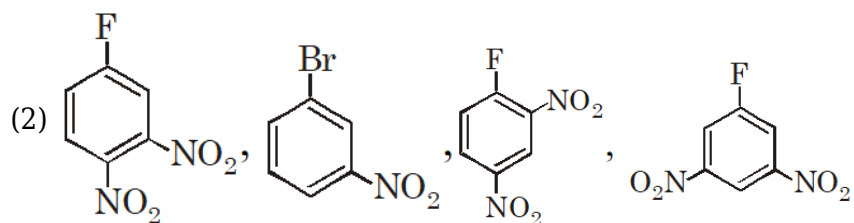
- (1) $\text{Ca}_2\text{B}_6\text{O}_{11}$
- (2) NaBO_2
- (3) $\text{Na}_2\text{B}_4\text{O}_7$
- (4) CaCO_3

8) The compound which is not associated with Solvay ammonia process for the production of Na_2CO_3

- (1) NH_4HCO_3
- (2) NaHCO_3
- (3) NaCl
- (4) $\text{Na}_2\text{C}_2\text{O}_4$

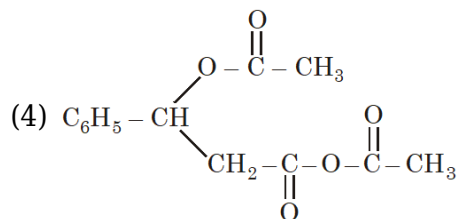
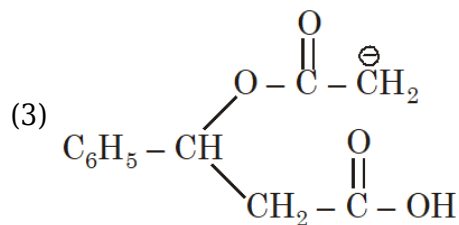
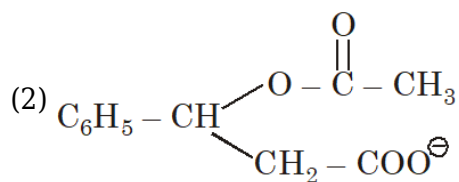
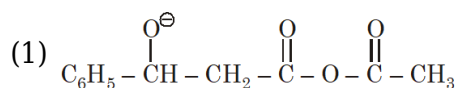
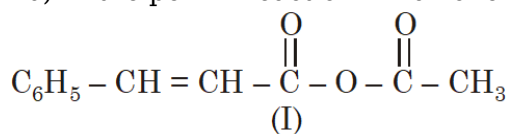
9) Which of the following correctly ranks the aryl halides in increasing order of reactivity towards CH_3O^- in CH_3OH ?





(4) All are correct

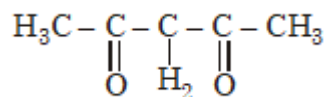
10) In the perkin reaction which one of the following intermediates gives compound (I)



11) Phenol is used as -

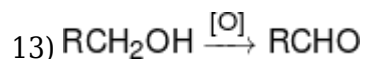
- (1) An antiseptic
- (2) A disinfectant
- (3) Both (1) and (2)
- (4) None of these

12) Observe the following reaction



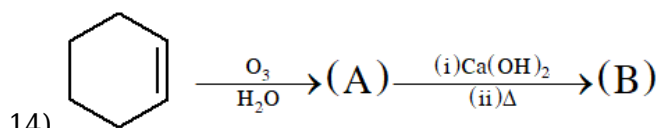
The incorrect statement is

- (1) The product is a mixture of two compounds
- (2) The product is optically inactive
- (3) The product is a mixture of two chiral and one achiral stereoisomer
- (4) The product is a mixture of three stereoisomers

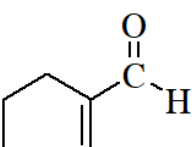
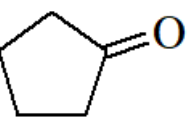
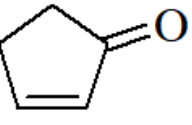
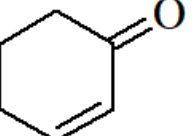


Which of the following oxidising agent is most suitable for above reaction?

- (1) PCC
- (2) $\text{K}_2\text{Cr}_2\text{O}_7$
- (3) KMnO_4
- (4) All



Product B is

- (1) 
- (2) 
- (3) 
- (4) 

15) Which is sandmeyer reaction in the followings:

- (1) $\text{C}_6\text{H}_5\text{N}_2\text{Cl} \xrightarrow[\Delta]{\text{HBF}_4} \text{C}_6\text{H}_5\text{F}$
- (2) $\text{C}_6\text{H}_5\text{N}_2\text{Cl} \xrightarrow{\text{Cu/HCl}} \text{C}_6\text{H}_5\text{Cl}$
- (3) $\text{C}_6\text{H}_5\text{N}_2\text{Cl} \xrightarrow{\text{Cu}_2\text{Cl}_2/\text{HCl}} \text{C}_6\text{H}_5\text{Cl}$
- (4) $\text{C}_6\text{H}_5\text{N}_2\text{Cl} \xrightarrow{\text{C}_6\text{H}_6/\text{NaOH}} \text{C}_6\text{H}_5\text{Cl}$

16) α -D-(+) glucose and β -D-(+) glucose are

- (1) Position isomers
- (2) Anomers
- (3) Enantiomers
- (4) Conformers

17) Proteins give white precipitate with Millon's reagent, which is -

- (1) Mercurous and mercuric nitrate in HNO_3
- (2) Mercurous and mercuric chloride in HCl
- (3) Mercurous and mercuric chloride in HNO_3
- (4) None

18) An ideal gas is subjected to cyclic process involving four thermodynamic states, the amounts of heat (Q) and work (W) involved in each of these process are -

$$Q_1 = 6000 \text{ J},$$

$$Q_2 = -5500 \text{ J};$$

$$Q_3 = -3000 \text{ J};$$

$$Q_4 = 3500 \text{ J}$$

$$W_1 = 2500 \text{ J};$$

$$W_2 = -1000 \text{ J};$$

$$W_3 = -1200 \text{ J};$$

$$W_4 = x \text{ J}.$$

The ratio of the net work done by the gas to the total heat absorbed by the gas is η . The values of $|x|$ and η respectively are

- (1) 500; 7.5%
- (2) 1300; 10.5%
- (3) 1000; 21%
- (4) None

19) Which one of the following is not the example of homogeneous catalysis :-

- (1) Formation of SO_3 in the chamber process
- (2) Formation of SO_3 in the contact process
- (3) Hydrolysis of an ester in presence of acid
- (4) Decomposition of KClO_3 in presence of MnO_2

20) Change in entropy is negative for :-

- (1) Bromine (ℓ) $\rightarrow$ Bromine (g)
- (2) $\text{C (s)} + \text{H}_2\text{O (g)} \rightarrow \text{CO (g)} + \text{H}_2\text{ (g)}$
- (3) $\text{N}_2\text{ (g, 10 atm)} \rightarrow \text{N}_2\text{ (g, 1 atm)}$
- (4) $\text{Fe (at 400 K)} \rightarrow \text{Fe (at, 300 K)}$

21) At 273 K and 10 bar, the Langmuir absorption of gas on a solid surface gave the fraction of

surface coverage as 0.1 the Langmuir adsorption isotherm constant is $1.01 \times 10^{-x} \text{ bar}^{-1}$. x is-

- (1) 0
- (2) 1
- (3) 2
- (4) 3

22) Percentage of Se in peroxidase anhydrous enzyme is 0.5% by weight (at. wt. = 78.4) then min. mol. wt. of peroxidase anhydrous enzymes is :-

- (1) 1.568×10^4
- (2) 1.568×10^3
- (3) 15.68
- (4) 2.136×10^4

23) During electrolysis of fused sodium chloride the reaction of the electrodes are :

- (1) Anode : $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}_{(\text{s})}$, Cathode : $\text{Cl}^- \rightarrow \times \text{Cl}_2 + \text{e}^-$
- (2) Anode : $\text{Na}_{(\text{s})} \rightarrow \text{Na}^+ + \text{e}^-$, Cathode : $\times \text{Cl}_2 + \text{e}^- \rightarrow \text{Cl}^-$
- (3) Anode : $\text{Cl}^- \rightarrow \times \text{Cl}_2 + \text{e}^-$, Cathode : $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}_{(\text{s})}$
- (4) Anode : $\times \text{Cl}_2 + \text{e}^- \rightarrow \text{Cl}^-$, Cathode : $\text{Na}_{(\text{s})} \rightarrow \text{Na}^+ + \text{e}^-$

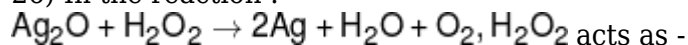
24) For which reaction, K_p is less than K_c at temperature $T = 10 \text{ K}$:

- (1) $\text{N}_2\text{O}_4 \rightleftharpoons 2\text{NO}_2$
- (2) $2\text{HI} \rightleftharpoons \text{H}_2 + \text{I}_2$
- (3) $2\text{SO}_2 \rightleftharpoons \text{O}_2 + 2\text{SO}_3$
- (4) $\text{N}_2 + \text{O}_2 \rightleftharpoons 2\text{NO}$

25) Which of the following are the correct axial distances and axial angles for rhombohedral system ?

- (1) $a = b = c, \alpha = \beta = \gamma \neq 90^\circ$
- (2) $a = b \neq c, \alpha = \beta = \gamma = 90^\circ$
- (3) $a \neq b = c, \alpha = \beta = \gamma = 90^\circ$
- (4) $a \neq b \neq c, \alpha \neq \beta \neq \gamma \neq 90^\circ$

26) In the reaction :



- (1) Bleaching agent
- (2) Oxidising agent

- (3) Reducing agent
- (4) None of these

27) Which of the following statements are false about AgI sol prepared by peptization of AgI with AgNO_3 .

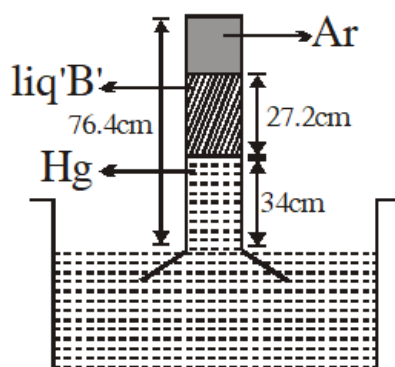
- (1) In electrophoresis, the dispersed phase will move towards cathode
- (2) AlCl_3 is more effective than Na_3PO_4 for bringing about coagulation of sol
- (3) Na_3PO_4 is more effective than AlCl_3 for bringing about coagulation of sol
- (4) On persistent dialysis of sol, precipitation of colloidal sol take place (coagulation)

28) In the following arrangement the weight of Ar gas (in gram) at 27°C will be

Use: $R = 0.08 \text{ atm L/mol K}$

Density of liq 'B' = 1 gm/ml

Atmosphere pressure = 760 mm Hg



Cross sectional area = 1 cm^2

- (1) $\frac{160.8}{76 \times 60}$
- (2) $\frac{1}{75}$
- (3) $\frac{305.6}{76 \times 60}$
- (4) None of these

29) The vapour pressure of condensate of vapours collected from a binary liquid solution of A and B which form ideal solution is 250 torr at 300 K. Assuming that the composition of liquid remains unchanged due to vaporisation in closed vessel, what is the value of vapour pressure of binary solution at 300 K in torr.

Given : $P_A^\circ = 300 \text{ torr}$
 $P_B^\circ = 300 \text{ torr}$

- (1) 240
- (2) 3
- (3) 15
- (4) 68

30) Which of the following aq. solution has maximum boiling point -

- (1) 1M NaCl
- (2) 1m urea
- (3) 0.1N H_2SO_4
- (4) 1M CaCl_2

PART-III : MATHEMATICS

1) A plane passes through the point P(4, 0, 0) and Q(0, 0, 4) and is parallel to the y-axis. The distance of the plane from the origin is -

- (1) 2
- (2) 4
- (3) $\sqrt{2}$
- (4) $2\sqrt{2}$

2) The value of $\sqrt{2} \cos 5^\circ \cos 55^\circ \cos 65^\circ$ is -

- (1) $\frac{\sqrt{3}+1}{8}$
- (2) $\frac{\sqrt{3}-1}{8}$
- (3) $\frac{\sqrt{3}+1}{4}$
- (4) $\frac{\sqrt{3}-1}{4}$

3) If the plane $2x - 3y + 6z - 11 = 0$ makes an angle $\sin^{-1}(k)$ with x-axis, then k is equal to -

- (1) $\frac{\sqrt{3}}{2}$
- (2) $\frac{2}{7}$
- (3) $\frac{\sqrt{2}}{3}$
- (4) 1

4) If α, β, γ are the roots of the equation $x^3 + 4x + 1 = 0$ then $(\alpha + \beta)^{-1} + (\beta + \gamma)^{-1} + (\gamma + \alpha)^{-1}$ is equal to-

- (1) 2
- (2) 3
- (3) 4
- (4) 5

5) In a $\triangle ABC$, $\angle B = 90^\circ$ and $a + b = 4$. The area of the triangle is maximum when $\angle A$ is -

- (1) $\frac{\pi}{4}$
 (2) $\frac{\pi}{6}$
 (3) $\frac{\pi}{3}$
 (4) $\frac{\pi}{2}$

6) $\triangle ABC$ is a right triangle with hypotenous AB and AC = 15 cm. Altitude cm divides AB into segments AM & MB with MB = 16 cm. Length of altitude is :-

- (1) 12 cm
 (2) 9 cm
 (3) 10 cm
 (4) None

7) The lateral edge of a regular hexagonal pyramid is 1 cm. If the volume is maximum, then its height must be equal to :

- (1) $\frac{1}{3}$
 (2) $\frac{2}{3}$
 (3) $\frac{1}{\sqrt{3}}$
 (4) 1

8) The range of the expression,

$$f(x) = \frac{x^3 + x^2 + x - 3}{x - 1} \text{ is -}$$

- (1) $[2, \infty)$
 (2) $(2, \infty)$
 (3) $[2, \infty) - \{6\}$
 (4) $(-1, \infty)$

9) Let $g(x) = \frac{1}{4}f(2x^2 - 1) + \frac{1}{2}f(1 - x^2) \forall x \in \mathbb{R}$, where $f''(x) > 0 \forall x \in \mathbb{R}$, $g(x)$ is necessarily increasing in the interval :-

- (1) $\left(-\sqrt{\frac{2}{3}}, \sqrt{\frac{2}{3}}\right)$
 (2) $\left(-\infty, -\sqrt{\frac{2}{3}}\right) \cup \left(\sqrt{\frac{2}{3}}, \infty\right)$
 (3) $(-1, 1)$
 (4) None of these

10) If the angles A, B and C of triangle ABC are in A.P., and the sides a, b and c opposite to these angles are in G.P., then a^2, b^2, c^2 are in -

- (1) A.P.
- (2) G.P.
- (3) H.P.
- (4) All of these

11) Let $f(x)$ be a differentiable function.

Let $h(x) = \frac{1}{3}(f(x))^3 + (f(x))^2 + (f(x)) + \frac{1}{3}$.

Which one of the following is correct ?

- (1) $h(x)$ increases as $f(x)$ increases
- (2) $h(x)$ always increases whether $f(x)$ increases or decreases
- (3) $h(x)$ increases as $f(x)$ decreases
- (4) Nothing can be said

12) The vertices of a triangle are A(0, 6), B(-6, 0) & C(6, 0). The maximum value of the radius of the circle touching the sides BC & arc BC of the circumcircle of $\triangle ABC$ -

- (1) 1
- (2) 2
- (3) 3
- (4) 4

13) Tangents are drawn to $y = \cos x$ from the point P(0, 0). Points of contacts of these tangents will always lie on -

- (1) $\frac{1}{x^2} = \frac{1}{y^2} + 1$
- (2) $\frac{1}{x^2} = \frac{1}{y^2} - 1$
- (3) $x^2 + y^2 = 1$
- (4) $x^2 - y^2 = 1$

14) If $a + b + c = 6$ where $a, b, c \in \mathbb{R}^+$ then the maximum value of $a^3 b^2 c$ is -

- (1) $3^2 \cdot 2^3$
- (2) $3^2 \cdot 2^2$
- (3) $3^3 \cdot 2^2$
- (4) 6

15) The length of the sub-tangent to the curve $y = \sqrt[3]{\frac{x^3(x^2 + 1)}{\sqrt[5]{5 - x}}}$ at $x = 1$ is-

- (1) $\frac{81}{20}$
 (2) $\frac{20}{81}$
 (3) $\frac{27}{20}$
 (4) $\frac{20}{27}$

16) If $\sin^3 x + \cos^3 x = 3(\sin x + \cos x) + 2$, then possible value of $\sin(2x)$ is -

- (1) $\frac{1}{2}$
 (2) 0
 (3) $-\frac{1}{2}$
 (4) None of these

17) A function $y = f(x)$ satisfies the differential equation, $\frac{dy}{dx} - y = \cos x - \sin x$, with initial condition that y is bounded when $x \rightarrow \infty$. The area enclosed by $y = f(x)$, $y = \cos x$ and the y -axis in the 1st quadrant is -

- (1) $\sqrt{2} - 1$
 (2) $\sqrt{2}$
 (3) 1
 (4) $\frac{1}{\sqrt{2}}$

18) Let $f : \mathbb{R} \rightarrow \mathbb{R}$, $f(x) =$ then the set of values of a for which $f(x)$ is onto, is -

- (1) $(-\infty, \infty)$
 (2) $(0, \infty)$
 (3) $(0, 1)$
 (4) No value

19) The area of the region consisting of all points (x, y) so that $x^2 + y^2 \leq 1$ $|x| + |y|$, is -

- (1) π
 (2) $\pi - 1$
 (3) $\pi - 2$
 (4) $\pi - 3$

20) If $A = \sin^4 \alpha + \cos^4 \alpha$ and $6 = \sin^6 \beta + \cos^6 \beta$, $\beta \in \mathbb{R}$, then the value of $[(A + 2B)_{\max}] + [(2A - B)_{\min}]$ is (where $[.]$ denotes greatest integer function) -

- (1) 2

- (2) 3
- (3) 4
- (4) 6

21) Coefficient of x^{65} in expansion of $\prod_{i=0}^{10} (i+x)^{i+1}$ is -

- (1) 650
- (2) 325
- (3) 440
- (4) 66

22) If z_1, z_2, z_3 are the vertices of the triangle on the complex plane & are also the roots of the equation $z^3 - 3\alpha z^2 + 3\beta z + \gamma = 0$, then the condition for the triangle to be equilateral triangle is -

- (1) $\alpha^2 = \beta$
- (2) $\alpha = \beta^2$
- (3) $\alpha^2 = 3\beta$
- (4) $\alpha = 3\beta^2$

23) The coefficient of x^4 in the expansion $(e^x - 1)^2$ is :

- (1) $\frac{3}{8}$
- (2) $\frac{5}{12}$
- (3) $\frac{7}{12}$
- (4) $\frac{5}{24}$

24) In $\triangle ABC$, $\angle A, \angle B$ & $\angle C$ forms an A.P.. The length of altitude from B to AC is equal

$\ell(AB) = \ell(BC)$. The value of $\sin\left(\frac{C-A}{2}\right)$ is -

- (1) $-\frac{1}{2}$
- (2) $\frac{1}{2}$
- (3) 0
- (4) 1

25) The sum of all the divisors of $2^5 \cdot 3^7 \cdot 5^3 \cdot 7^2$ is:

- (1) $2^6 \cdot 3^8 \cdot 5^4 \cdot 7^3 - 2 \cdot 3 \cdot 5 \cdot 7$
- (2) $2^6 \cdot 3^8 \cdot 5^4 \cdot 7^3$

(3) $2^6 \cdot 3^8 \cdot 5^4 \cdot 7^3 - 1$

(4) $\frac{(2^6 - 1)(3^8 - 1)(5^4 - 1)(7^3 - 1)}{2 \cdot 4 \cdot 6}$

26) $\tan 9^\circ - \tan 27^\circ - \tan 63^\circ + \tan 81^\circ$ is equal to-

- (1) 2
- (2) 3
- (3) 4
- (4) 5

27) If $\int e^{\cot x} (\cos x - \operatorname{cosec} x) dx = e^{f(x)} g(x) + c$ where $x \in \left(0, \frac{\pi}{2}\right)$, $f(x) \in \mathbb{R}$ & $g(x) \in [-1, 1]$ then :-

- (1) $f(x) g(x) = 1$
- (2) $f^2(x) - g^2(x) = 1$
- (3) $g^2(x) (1 + f^2(x)) = 1$
- (4) $(f^2(x) + 1) = f^2(x) g^2(x)$

28) If $\operatorname{Re}(z) = \min\{|z+1|, |z-1|\}$, then $\operatorname{Re}(z)$ can not be equal to -

- (1) 0
- (2) 1
- (3) 2
- (4) 3

29) If $\int \sec 2x dx = f(g(x)) + c$ where $f(x) = \frac{1}{2} \ln |x|$, then incorrect statement is -

- (1) Domain of $f(x) = \mathbb{R} - \{0\}$
- (2) Range of $g(x) = \mathbb{R}$
- (3) $f'(x) = \frac{1}{2x}$, $x \neq 0$, $x \in \mathbb{R}$
- (4) $g'(x) = 2 \operatorname{cosec}^2\left(\frac{\pi}{4} - x\right)$

30) Let $\mathbb{C}$ denotes the set of complex numbers and define A and B by

$$A = \{(z, \omega) : z, \omega \in \mathbb{C} \text{ and } |z| = |\omega|\}$$

$$B = \{(z, \omega) : z, \omega \in \mathbb{C} \text{ and } z^2 = \omega^2\}$$

Then :-

- (1) $A = B$
- (2) $A \subset B$
- (3) $B \subset A$
- (4) None of these

31) Given the vectors $\vec{a}$ & $\vec{b}$ the angle between which equals 120° . If $|\vec{a}| = 3$ & $|\vec{b}| = 4$, then the length of the vector, $2\vec{a} - \frac{3}{2}\vec{b}$ is :

- (1) $6\sqrt{3}$
- (2) $7\sqrt{2}$
- (3) $4\sqrt{5}$
- (4) None

32) If z_1 & z_2 are two complex numbers & if $\arg \frac{z_1 + z_2}{z_1 - z_2} = \frac{\pi}{2}$ but $|z_1 + z_2| \neq |z_1 - z_2|$ then the figure formed by the points represented by 0, z_1 , z_2 , & $z_1 + z_2$ is -

- (1) A parallelogram but not a rectangle or a rhombus
- (2) A rectangle but not a square
- (3) A rhombus but not a square
- (4) A square

33) If $\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \dots + \text{to } \infty = \frac{\pi^4}{90}$, then $\frac{1}{1^4} + \frac{1}{3^4} + \frac{1}{5^4} + \dots + \text{to } \infty$ is equal to -

- (1) $\frac{\pi^4}{96}$
- (2) $\frac{\pi^4}{45}$
- (3) $\frac{89\pi^4}{90}$
- (4) None of these

34) If $\min.(x^2 + (a - b)x + (1 - a - b)) > \max.(-x^2 + (a + b)x - (1 + a + b))$, then :-

- (1) $a^2 + b^2 < 4$
- (2) $a^2 + b^2 = 4$
- (3) $a^2 + b^2 > 4$
- (4) $a^2 - b^2 < 4$

35) If $a \in [-20, 0]$, then probability that the graph of the function $y = 16x^2 + 8(a + 5)x - 7a - 5$ is strictly above the x-axis is -

- (1) $3/20$
- (2) $13/20$
- (3) $17/20$
- (4) $1/2$

36) The length of common tangent to the parabolas $y^2 = 4(x - 1)$ and $y^2 = 8x + 4y - 12$ is -

- (1) 1
- (2) 2
- (3) 3
- (4) 4

37) If $I_1 = \int_0^x e^{zx} e^{-z^2} dz$ and $I_2 = \int_0^x e^{-z^2/4} dz$ then :

- (1) $I_1 = e^x I_2$
- (2) $I_1 = e^{x^2} I_2$
- (3) $I_1 = e^{x^2/2} I_2$
- (4) None of these

38) The value of 'a' for which $ax + \sin^{-1}(4x - x^2 - 5) + \cos^{-1}(4x - x^2 - 5) = 0$ has a real solution, is -

- (1) $-\frac{\pi}{2}$
- (2) $-\frac{\pi}{4}$
- (3) $\frac{\pi}{4}$
- (4) Infinitely many solutions

39) An ellipse having foci at (3, 3) and (-4, 4) and passing through the origin has eccentricity equal to-

- (1) $\frac{3}{7}$
- (2) $\frac{2}{7}$
- (3) $\frac{5}{7}$
- (4) $\frac{3}{5}$

40) The intercept made by the plane $\vec{r} \cdot \vec{n} = q$ on the x-axis is -

- (1) $\frac{q}{\hat{i} \cdot \vec{n}}$
- (2) $\frac{\hat{i} \cdot \vec{n}}{q}$
- (3) $(\hat{i} \cdot \vec{n}) q$
- (4) $\frac{q}{|\vec{n}|}$

PART-IV(A) : English Proficiency

1) Choose a suitable question tag for the given sentence.

The party is tomorrow at 5 pm, _____?

- (1) Doesn't it
- (2) Isn't the party
- (3) Isn't it
- (4) Musn't it

2) Select the most suitable alternative to replace the underlined word in the given sentence to make the sentence grammatically correct.

A noun may proceed an adjective in a sentence.

- (1) No change
- (2) Proceeds
- (3) Cede
- (4) Precede

3) Select the most suitable alternative to fill the blank in the below given sentence.

In their quest to find the truth behind the accident, they have _____ the real culprit.

- (1) Come across
- (2) Come along
- (3) Come back
- (4) Come apart

4) Choose the word which is opposite in meaning of the underlined word in the given sentence.

Flagitious men should be sentenced to death to prevent them from committing the crimes again

- (1) Feeble
- (2) Ignorant
- (3) Innocent
- (4) Fatuous

5) Select the correct word from the given options to replace the question mark in the given analogy.

Humidity : Hygrometer :: Wind : ?

- (1) Osmometer
- (2) Anemometer
- (3) Theodolite
- (4) Ammeter

6) Choose the correct helping verb to fill the blank given in the sentence in passive voice.

Active Voice: My daughter has gifted me a beautiful watch on the occasion of my 50th birthday.

Passive Voice: A beautiful watch _____ gifted to me by my daughter on the occasion of my 50th

birthday.

- (1) Was
- (2) Had been
- (3) Has been
- (4) Will be

7) Directions :

Read the following passage carefully and mark the correct answer for the questions given below.

A recent report in News Week says that in American colleges, students of Asian origin outperform not only the minority group students but the majority whites as well. Many of these students must be of Indian origin, and their achievement is something we can be proud of. It is unlikely that these talented youngsters will come back to India, and that is the familiar brain drain problem. However recent statements by the nation's policy-makers indicate that the perception of this issue is changing. 'Brain bank' and not 'brain drain' is the more appropriate idea, they suggest since the expertise of Indians abroad is only deposited in other places and not lost.

This may be so, but this brain bank, like most other banks, is one that primarily serves customers in its neighbourhood. The skills of the Asians now excelling in America's colleges will mainly help the USA. No matter how significant, what non-resident Indians do for India and what their counterparts do for other Asian lands is only a by-product.

But it is also necessary to ask, or be reminded, why Indians study fruitfully when abroad. The Asians whose accomplishments News Week records would have probably had a very different tale if they had studied in India. In America they found elbow room, books and facilities not available and not likely to be available here. The need to prove themselves in their new country and the competition of an international standard they faced there must have cured mental and physical laziness. But other things helping them in America can be obtained here if we achieve a change in social attitudes, especially towards youth.

We need to learn to value individuals and their unique qualities more than conformity and respectability. We need to learn the language of encouragement to add to our skill in flattery. We might also learn to be less liberal with blame and less tight-fisted with appreciation, especially.

Among all the students of different nations in American colleges, Asian students:

- (1) Are most successful academically.
- (2) Have proved that they are as good as the whites
- (3) Are often written about in magazines like News Week.
- (4) Have only a minority status like the blacks

8) Directions :

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The brain bank has limitations like all banks in the sense that:

- (1) No one can be forced to put his assets in a bank
- (2) Small neighbourhood banks are not visible in this age of multinationals
- (3) A bank's services go mainly to those near it
- (4) Only what is deposited can be withdrawn and utilized

9) **Directions :**

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In general, the talented young Indians studying in America:

- (1) Have the opportunity to contribute to India's development.
- (2) Can solve the brain drain problem because of recent changes in policy
- (3) Will not return to pursue their careers in India
- (4) Have a reputation for being hard working.

10) **Directions :**

Read the following passage carefully and mark the correct answer for the questions given below.

A recent report in News Week says that in American colleges, students of Asian origin outperform not only the minority group students but the majority whites as well. Many of these students must be of Indian origin, and their achievement is something we can be proud of. It is unlikely that these talented

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But it is also necessary to ask, or be reminded, why Indians study fruitfully when abroad. The Asians whose accomplishments News Week records would have probably had a very different tale if they had studied in India. In America they found elbow room, books and facilities not available and not likely to be available here. The need to prove themselves in their new country and the competition of an international standard they faced there must have cured mental and physical laziness. But other things helping them in America can be obtained here if we achieve a change in social attitudes, especially towards youth.

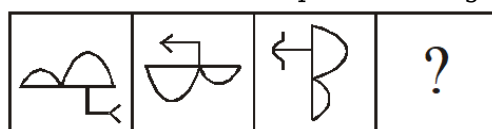
We need to learn to value individuals and their unique qualities more than conformity and respectability. We need to learn the language of encouragement to add to our skill in flattery. We might also learn to be less liberal with blame and less tight-fisted with appreciation, especially.

The author feels that some of the conditions other than the level of facilities that make the West attractive:

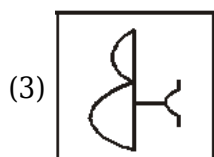
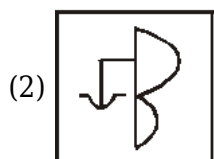
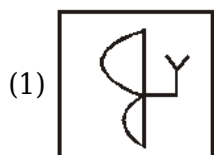
- (1) Can be created if our attitudes and values change
- (2) Can also give respectability to our traditions and customs
- (3) Can never be found here because we believe in conformity
- (4) Are available in India but young people do not appreciate them

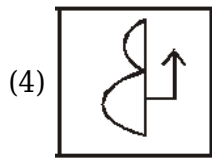
PART-IV(B) : Logical Reasoning

1) Following question consists of two set of figures. Figure 1,2, 3 and 4 constitutes the problem set while figures A, B, C and D constitutes the answer set. There is a definite relationship between figure A and B. Establish a similar relationship between figure C and D by choosing a suitable figure

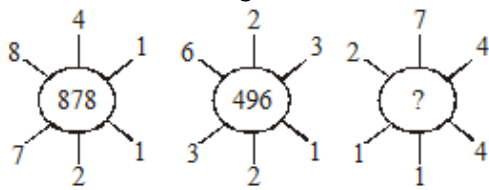


D from the answer set.



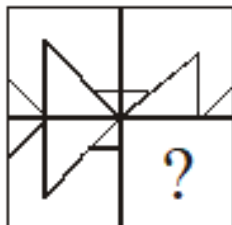


2) Find the missing character in the following :

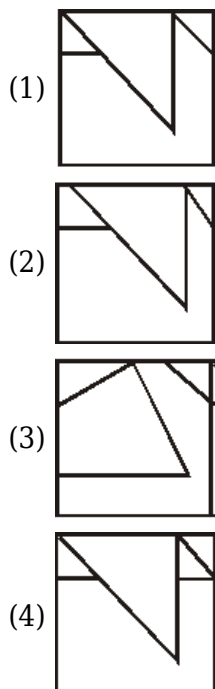


- (1) 212
- (2) 586
- (3) 958
- (4) 748

3) In the following question, complete the missing segment by selecting from the given alternatives,



(A), (B), (C) and (D).



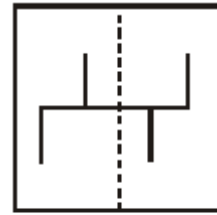
4) Three of the following four are alike in a certain way and so form a group. Which is the one that does not belong to that group?

- (1) FL5
- (2) PY8

(3) RV3

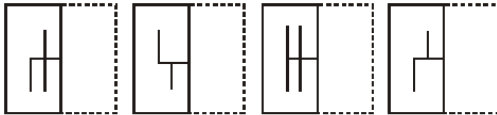
(4) JR6

5) Find out from amongst the four alternatives as to how the pattern would appear when the



(X)

transparent sheet is folded at the dotted line shown in the figure (X)



(1)

(2)

(3)

(4)

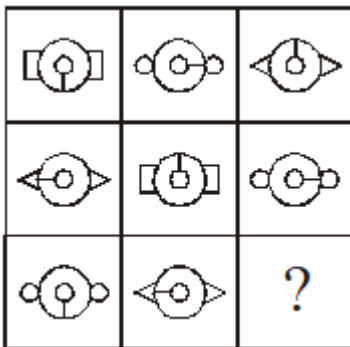
(1) 1

(2) 2

(3) 3

(4) 4

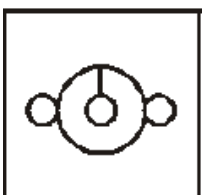
6) Select a suitable figure from the four alternatives that would complete the figure matrix.



(1)

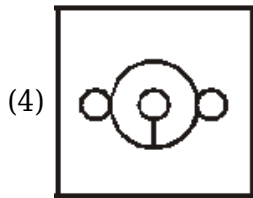


(2)



(3)



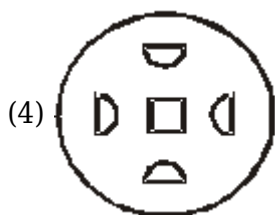
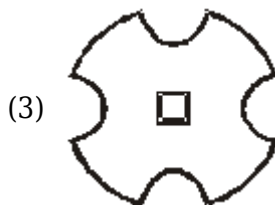
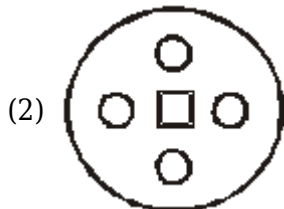
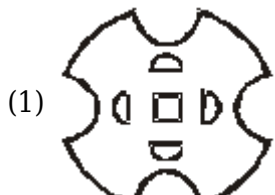
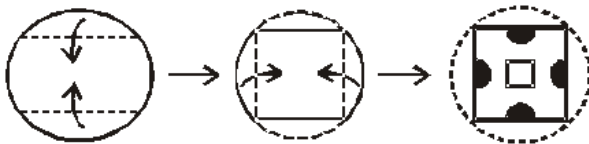


7) In the following question, there is some relationship according to some rule between the letters and numbers given in each row. Find the rule in each case and then choose the correct alternative from among the four alternatives given under it satisfying the same rule to fill in the vacant places in

	AL	145	39	CF
	CP	259	104	DJ
the third row.	GM	?	?	LM

- (1) 9,29
- (2) 18, 210
- (3) 179, 239
- (4) 176, 181

8) Choose the alternative which is closely resembles the paper cutting of the given figure.



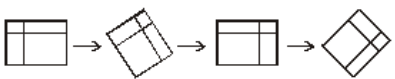
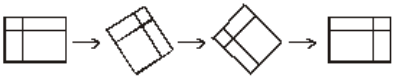
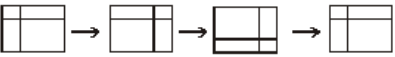
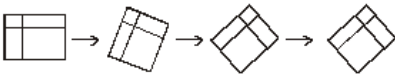
9) Find the next term in the alpha-numeric series:

Y1A, W16D, U49G, S100J, Q169M, ?

- (1) N267S
- (2) O256P
- (3) T267N
- (4) N267T

10) Which of the following series of figures follows the given rule?

Rule: The image rotates clockwise 45 degrees as it moves one step forward towards the right side.

- (1) 
- (2) 
- (3) 
- (4) 

11) Choose from the following options which will continue the series given below :

P 3 C, R 5 F, T 8 I, V 12 L, ?

- (1) Y 17 O
- (2) X 17 M
- (3) X 17 O
- (4) X 16 O

12) **Directions :**

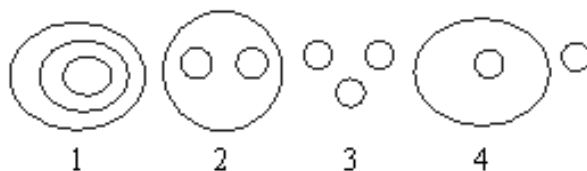
A successive follow up of directions is formulated and the candidate is required to ascertain the final direction or the distance between two points.

A man is facing south. He turns in the anticlockwise direction and then in the clockwise direction. Which direction is he facing now ?

- (1) North-East
- (2) North-West
- (3) South-East
- (4) South-West

13) **Direction :**

Four sets of circles has been given below. Three circles of set have some relation with each other. Question given below have three words each which are also related to each other in some way. This relation between words is similar to that in one of circles. Find it out from the four four options given below each question and write its serial number against corresponding question number



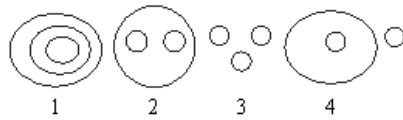
on your answer sheet-

Family, Mother, Father

- (1) 2
- (2) 4
- (3) 3
- (4) 1

14) **Direction :**

Four sets of circles has been given below. Three circles of set have some relation with each other. Question given below have three words each which are also related to each other in some way. This relation between words is similar to that in one of circles. Find it out from the four four options given below each question and write its serial number against corresponding question number



on your answer sheet-

1

2

3

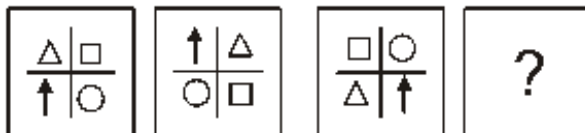
4

Book, Page, Words

- (1) 3
- (2) 4
- (3) 1
- (4) 2

15) **Directions :**

In the following questions numbers/ letters/figures are arranged on the basis of some logic. Find out the logic and select the correct answer and fill in the missing term/figure from the given alternatives.



- (1)
- (2)
- (3)
- (4)

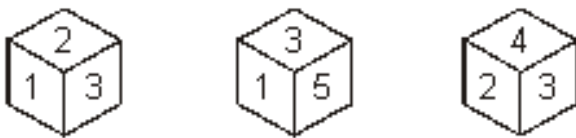
16) Asha walks 3 km. southward and then turns right and walks 2 km. She again turns right and walks 3 km. and turns towards her left and starts walking straight. In which direction is she walking now?

- (1) East
- (2) North
- (3) South
- (4) West

17) If January 1 is a Friday, then what is the first day of the month of March in a leap year?

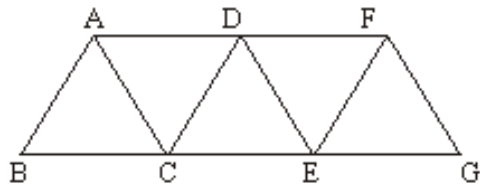
- (1) Tuesday
- (2) Wednesday
- (3) Thursday
- (4) Friday

18) Three positions of a dice are given below. Which number is opposite to face 3?



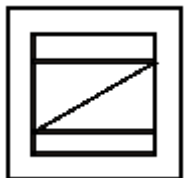
- (1) 1
- (2) 6
- (3) 5
- (4) 4

19) How many parallelograms are there in the following figure?

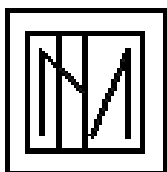


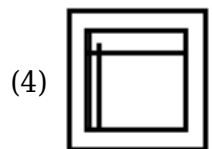
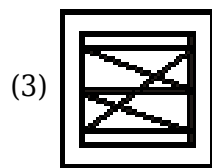
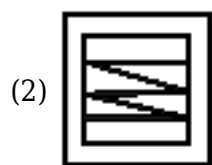
- (1) 4
- (2) 5
- (3) 6
- (4) 8

20) Problem figure :



- (1)





ANSWER KEYS

PART-I : PHYSICS

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A.	2	2	3	2	1	2	2	3	4	3	2	1	1	2	4	2	1	2	3	1
Q.	21	22	23	24	25	26	27	28	29	30										
A.	4	3	1	2	2	1	3	3	2	3										

PART-II : CHEMISTRY

Q.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
A.	4	3	1	2	4	1	3	4	1	1	3	1	1	2	3	2	1	2	2	4
Q.	51	52	53	54	55	56	57	58	59	60										
A.	4	1	3	1	1	3	2	2	1	4										

PART-III : MATHEMATICS

Q.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
A.	4	1	2	3	2	1	3	1	4	4	1	3	2	3	3	2	1	4	3	2
Q.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
A.	3	1	3	2	4	3	3	1	4	3	1	3	1	1	2	2	4	2	3	1

PART-IV(A) : English Proficiency

Q.	101	102	103	104	105	106	107	108	109	110
A.	3	4	1	3	2	3	2	3	3	1

PART-IV(B) : Logical Reasoning

Q.	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130
A.	3	4	1	4	3	1	4	3	2	1	3	4	1	3	1	4	1	2	3	3

SOLUTIONS

PART-I : PHYSICS

$$T_1 = \frac{2u \sin \theta}{g}, T_2 = \frac{2u \cos \theta}{g} \text{ and}$$

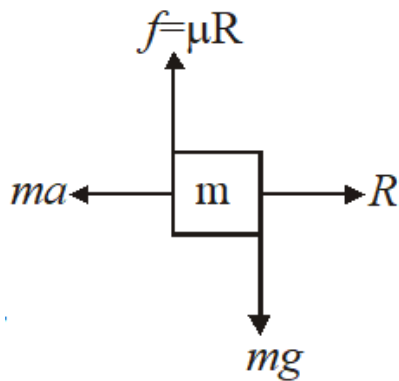
$$R = \frac{u^2 \sin 2\theta}{g}$$

$$1) \Rightarrow R = \frac{T_1 T_2 g}{2}$$

$$u_x = 4 \cos 30^\circ = 2\sqrt{3} \text{ m/s}$$

$$2) \text{ and } u_y = 4 \sin 30^\circ = 2 \text{ m/s}$$

$$T = \frac{2u_y}{12} = \frac{u_y}{6} = \frac{2}{6} = \frac{1}{3} \text{ s}$$



$$3) \sum F_y = 0, R = ma$$

$$Mg = \mu R = \mu ma$$

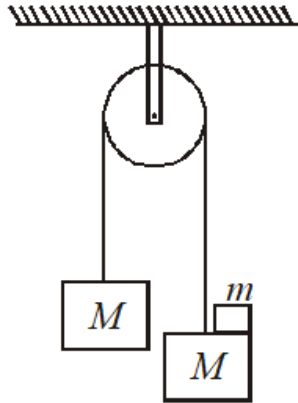
$$\mu = \frac{g}{a} = 0.5$$

4) Acceleration of blocks

$$= \frac{(M + m)g - Mg}{2M + m} = \frac{mg}{2M + m}$$

Considering free body diagram of block m only

$$mg - N = ma$$



$$N = m(g - a) = m \left[g - \frac{mg}{2M + m} \right]$$

$$N = \frac{2mMg}{2M + m}$$

$$12.75 = E_0 - \frac{E_0}{n^2} = -13.6 - \frac{(-13.6)}{n_1^2}$$

5)

$$\Rightarrow n = 4$$

$$\text{no. of lines} = \frac{n(n-1)}{2} = 6$$

6) Since, $\beta = \frac{\alpha}{1-\alpha} \Rightarrow \alpha\beta = \frac{\alpha^2}{1-\alpha}$

$$\beta - \alpha = \frac{\alpha}{1-\alpha} - \alpha = \frac{\alpha^2}{1-\alpha}$$

$$\therefore \left(\frac{\beta - \alpha}{\alpha\beta} \right) = \left(\frac{\alpha^2}{1-\alpha} \right) \left(\frac{1-\alpha}{\alpha^2} \right) = 1$$

7) For refraction at spherical surface

$$\frac{\mu}{v} - \frac{1}{\infty} = \frac{\mu - 1}{R}$$

$$\Rightarrow v = \frac{\mu}{\mu - 1} R = 3R$$

8) $I = 4I_0 \cos^2 \frac{\phi}{2} \Rightarrow 2I_0 = 4I_0 \cos^2 \frac{\phi}{2}$

$$\Rightarrow \cos \frac{\phi}{2} = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \phi = 2 \times \frac{\pi}{4} = \frac{\pi}{2}$$

Path difference $\Delta x = \frac{\lambda}{2\pi} \times \phi = \frac{\lambda}{2\pi} \frac{\pi}{2} = \frac{\lambda}{4}$

$$\Rightarrow (\mu - 1)t = \frac{\lambda}{4} \text{ or}$$

$$0.5t = \frac{\lambda}{4} \Rightarrow t_{\min} = \frac{\lambda}{2}$$

9) Conserving flux in the inductor of inductance L

$$L \cdot \frac{\varepsilon}{R} = L i'$$

$\Rightarrow$ New current after the switch is shifted to 2 is $\frac{\varepsilon}{R}$ which is the steady current in the circuit.
So, current will not change.

10) $X_L \neq X_C$, if frequency increases X_L will increase and X_C will decrease.

11) Spring constant, $k = \frac{F}{x} = \frac{4 \times 9.8}{0.02} = 1960 \text{ N/m}$

Work done $= \frac{1}{2}k[(x+y)^2 - x^2] = 4.41 \text{ J}$

12) Let $x\%$ of the length L over hang

$$\therefore \mu \left(\frac{100-x}{100} \right) Mg = \frac{x}{100} Mg$$

$$\Rightarrow 0.25(100-x) = x$$

$$\Rightarrow x = 20\%$$

13) Direction of magnetic moment and direction of magnetic field is parallel, then torque acting on the loop is zero.

14) For terminal velocity

Net force = 0

So, $m_1 g = F_m$

$$m_1 g = BIl = B \left(\frac{Blv}{R} \right) l,$$

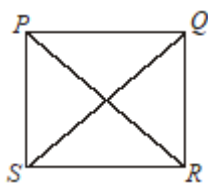
$$v = \frac{m_1 g R}{B^2 l^2}$$

15) After n th rebound velocity $= e^n u$, height

$$h_1 = \frac{v^2}{2g} = \frac{e^{2n} u^2}{2g} = \frac{e^{2n} u^2}{2g} = \frac{e^{2n} \times 2gh}{2g} = h e^{2n}$$

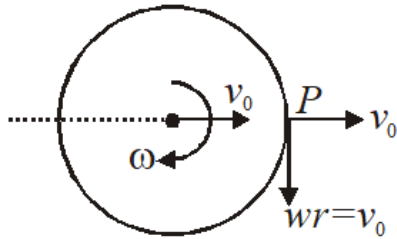
17) $B = \frac{\mu_0 I}{4r} + \frac{\mu_0 I}{4\pi r} = \frac{\mu_0 I}{4\pi r} (1 + \pi)$

18) $I_{PR} = I_{QS} = \frac{Ml^2}{12}$



Hence only for triangular part $\frac{Ml^2}{12}$ where M is the mass of the triangular sheet

$$19) v_p = \sqrt{v_0^2 + v_0^2} = \sqrt{2} v_0$$



$$20) \text{C.M.} = \frac{\pi R^2 \rho (0) - \frac{\pi R^2 \rho}{14} \left(\frac{3R}{4} \right)}{\pi R^2 \rho - \frac{\pi R^2 \rho}{16}} = -\frac{R}{20}$$

21) The equivalent resistance between points A and B to the right of AB is 4Ω . Therefore, total resistance = $3 + 4 + 2 = 9 \Omega$. Current

$I = 9 \text{ V} / 9 \Omega = 1 \text{ A}$. This current is equally divided in the 8Ω resistor between A and B and the remainder 8 W resistor. Hence current in AC = 0.5 A . This current is equally divided between the 8Ω resistor in CD and the circuit to the right of CD. Therefore, current in the 4Ω resistor = 0.25 A .

22) By the law of conservation of energy

$$-\frac{GMm}{R} + \frac{1}{2}mv^2 = -\frac{GMm}{10R+R} + 0$$

$$v = \sqrt{\frac{20}{11} \left(\frac{GM}{R} \right)} = \sqrt{\frac{20}{11} gR}$$

23) (i) The weight of the body at the centre of the earth is equal to zero because

$$g_{\text{centre}} = g \left(1 - \frac{d}{R} \right) = g \left(1 - \frac{R}{R} \right) = 0$$

$$(ii) \frac{g_1}{g} = \left(1 - \frac{d}{R} \right) = \frac{(R-d)}{R}$$

$$\Rightarrow R-d = \frac{g_1}{g} R = \frac{R}{4}$$

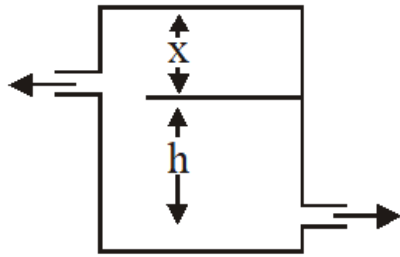
$$24) \Delta I = \frac{FL}{AY}$$

$$\frac{\Delta I_s}{\Delta I_B} = \frac{F_s}{F_B} \times \frac{L_s}{L_B} \times \frac{A_B}{A_s} \times \frac{Y_B}{Y_s}$$

$$= \frac{3M}{2M} \times a \times \frac{1}{b^2} \times \frac{1}{c} = \frac{3a}{2b^2c}$$

$$v_1 = \sqrt{2g(h+x)}$$

$$25) v_2 = \sqrt{2gx}$$



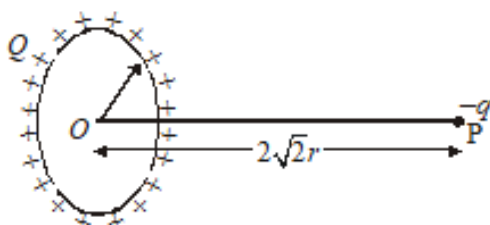
Net force on the tank

$$= \rho A (v_1^2 - v_2^2)$$

$$= \rho A [2g(h + x) - 2gx] = 2\rho Agh$$

$$26) \quad V = \frac{1}{4\pi\epsilon_0} \cdot \frac{q}{\left(\frac{b\sqrt{3}}{2}\right)} \times 8 = \frac{4q}{\sqrt{3}\pi\epsilon_0 b}$$

$$27) \text{ K.E. of } -q \text{ at } O = q(V_O - V_P)$$



$$= q \left[\frac{Q}{4\pi\epsilon_0 r} - \frac{Q}{4\pi\epsilon_0 \sqrt{r^2 + (2\sqrt{2}r)^2}} \right]$$

$$= \frac{2}{3} \frac{qQ}{4\pi\epsilon_0 r} = \frac{qQ}{6\pi\epsilon_0 r}$$

28) in process AB, $V \propto R$

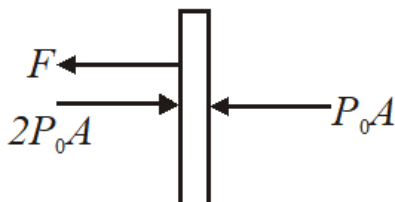
$$V = kP$$

$$PV = nRT$$

$$T = \frac{k}{nR} p^2, \text{ parabolic}$$

29) $P \propto T$

Pressure will be double if temperature is double



$$F = (2P_0 - P_0)A = P_0 A$$

30) As $P \propto l$,

$$\therefore SL_2 - SL_1 = 10 \log \left(\frac{l_2}{l_1} \right) = 10 \log \left(\frac{P_2}{P_1} \right)$$

PART-II : CHEMISTRY

34)

'N shell' $n = 4$

4s 4p 4d 4f $\Rightarrow$ orbitals.

General electronic configuration of lanthanides is $[\text{Xe}] 4f^{0-14} 5d^{0-1} 6s^2$

$\text{La}^{3+} : [\text{Xe}]$

$\text{Lu}^{3+} : [\text{Xe}] 4f^{14} *$

$\text{Gd}^{3+} : [\text{Xe}] 4f^7$

$\text{Ce}^{4+} : [\text{Xe}]$ 4f fully filled

$\text{Yb}^{2+} : [\text{Xe}] 4f^{14} *$

$\text{Tb}^{3+} : [\text{Xe}] 4f^8$

PART-III : MATHEMATICS

62) $\sqrt{2} \cos 5^\circ \cos 55^\circ \cos 65^\circ$

Apply $\cos \theta \cos(60^\circ - \theta) \cos(60^\circ + \theta) = \frac{1}{4} \cos 3\theta$

$$\sqrt{2} \cos 5^\circ \cos 55^\circ \cos 65^\circ = \frac{\sqrt{2}}{4} \cos 15^\circ$$

$$\frac{\sqrt{2}(\sqrt{3}+1)}{4 \cdot 2\sqrt{2}} = \frac{\sqrt{3}+1}{8}$$

64) α, β, γ are roots of $x^3 + 4x + 1 = 0 \Rightarrow \alpha + \beta + \gamma = 0, \alpha\beta + \beta\gamma + \gamma\alpha = 4$ and $\alpha\beta\gamma = -1$

Now

$$\begin{aligned} & \frac{1}{\alpha + \beta} + \frac{1}{\beta + \gamma} + \frac{1}{\gamma + \alpha} \\ &= \frac{1}{-\gamma} + \frac{1}{-\alpha} + \frac{1}{-\beta} = -\left(\frac{\alpha\beta + \beta\gamma + \gamma\alpha}{\alpha\beta\gamma}\right) = 4 \end{aligned}$$

65) $A = \frac{1}{2}a\sqrt{b^2 - a^2}$

$$= \frac{1}{2}a\sqrt{(4-a)^2 - a^2}$$

$$= \frac{1}{2}a\sqrt{16-8a}$$

$$\begin{aligned} \frac{dA}{da} &= \frac{1}{2} \left[a \left(\frac{-8}{2\sqrt{16-8a}} \right) + \sqrt{16-8a} \right] = 0 \\ 4a + 16 - 8a &= 0 \end{aligned}$$

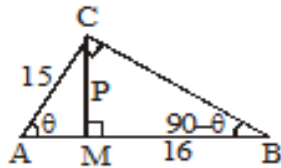
$$\Rightarrow 16 - 12a = 0$$

$$\Rightarrow a = \frac{4}{3} \text{ (point of maxima)}$$

$$b = 4 - \frac{4}{3} = \frac{8}{3}$$

$$\sin \theta = \frac{a}{b} = \frac{4/3}{8/3} = \frac{1}{2}$$

$$\Rightarrow \theta = \frac{\pi}{6}$$



$$66) \quad \therefore P = 15 \sin \theta \quad P = 16 \cot \theta$$

$$15 \sin \theta = 16 \cot \theta$$

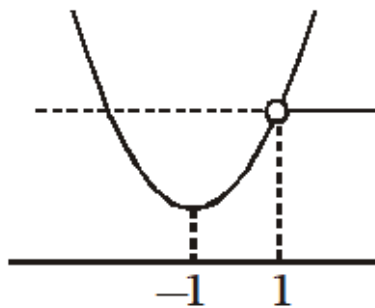
$$15 \sin \theta = 16 \cos \theta$$

Solving

$$\therefore P = 15 \times \frac{4}{5} \quad \cos \theta = \frac{3}{5}$$

$$P = 12 \text{ cm} \quad \therefore \sin \theta = \frac{4}{5}$$

$$67) \text{ Put } \frac{dy}{dx} = 0 \text{ for the pyramid}$$



68)

$$f(x) = \frac{x^3 + x^2 + x - 3}{x - 1}$$

$$\Rightarrow f(x) = (x^2 + 2x + 3) \quad x \neq 1$$

The graph of $f(x)$ is shown in figure, that shows $f(1)$ is included from left branch hence its range is $[2, \infty)$

$$69) \quad f''(x) > 0 \Rightarrow f'(x) \text{ is increasing function}$$

$$g'(x) = x \left((f' 2x^2 - 1) - f'(1 - x^2) \right)$$

(a) $x > 0$

$$\phi'(2x^2 - 1) - \phi'(1 - x^2) > 0$$

$$2x^2 - 1 > 1 - x^2$$

$$x^2 > \frac{2}{3}$$

$$x > \sqrt{\frac{2}{3}} \cup x < -\sqrt{\frac{2}{3}}$$

$$\text{intersection } x > \sqrt{\frac{2}{3}}$$

(b) $x < 0$

$$f'(2x^2 - 1) < f'(1 - x^2)$$

$$x^2 < \frac{2}{3}$$

$$-\sqrt{\frac{2}{3}} < x < \sqrt{\frac{2}{3}}$$

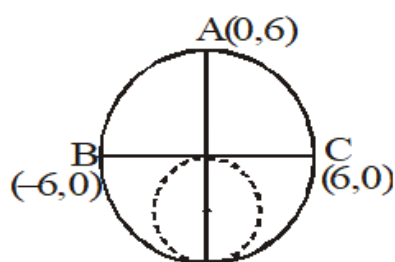
$$\text{intersection } -\sqrt{\frac{2}{3}} < x < 0$$

71) $h'(x) = \{(f(x))^2 + 2f(x) + 1\} f'(x)$

$$h'(x) = (f(x) + 1)^2 \cdot f'(x)$$

If $f'(x) \geq 0 \Rightarrow h'(x) \geq 0$

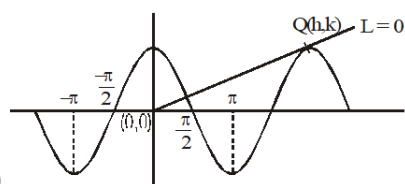
hence if $f(x)$ increases, $h(x)$ also increases.



72)

From the figure

maximum radius = 3



73)

Let $Q(h, k)$ be point of contact & m be the slope of the tangent

$$\therefore \frac{k}{h} = -\sin h \quad \dots\dots\dots (i)$$

Also $Q(h, k)$ lies on the curve

$$\therefore k = \cos h \quad \dots\dots\dots (ii)$$

$$(i)^2 + (ii)^2 \Rightarrow \cos^2 h + \sin^2 h = k^2 + \frac{k^2}{h^2}$$

$$\Rightarrow \frac{1}{y^2} = 1 + \frac{1}{x^2}$$

$$74) \frac{\frac{a}{3} + \frac{a}{3} + \frac{a}{3} + \frac{b}{2} + \frac{b}{2} + c}{6} \geq \left(\frac{a^3}{27} \cdot \frac{b^2}{4} \cdot c \right)^{1/6}$$

$$\Rightarrow \left(\frac{a^3}{27} \cdot \frac{b^2}{4} \cdot c \right) \leq 1 \Rightarrow a^3 b^2 c \leq 3^3 \cdot 2^2$$

$$75) \ell n y = \frac{1}{3} \left\{ 3 \ell n x + \ell n(x^2 + 1) - \frac{1}{5} \ell n(5 - x) \right\}$$

$$\frac{1}{y} \cdot y' = \frac{1}{3} \left\{ \frac{3}{x} + \frac{2x}{x^2 + 1} + \frac{1}{5(5 - x)} \right\}$$

$$\frac{y'}{y} = \frac{1}{3} \left\{ 3 + 1 + \frac{1}{20} \right\} = \text{length of sub-tangent}$$

$$76) (\sin x + \cos x)^3 - 3 \sin x \cos x (\sin x + \cos x)$$

$$= 3(\sin x + \cos x) + 2$$

$$\Rightarrow (\sin x + \cos x)^3 - \frac{3((\sin x + \cos x)^2 - 1)}{2} (\sin x + \cos x)$$

$$\Rightarrow t^3 - \frac{3(t^2 - 1)t}{2} = 3t + 2$$

$$= 3(\sin x + \cos x) + 2$$

Let $\sin x + \cos x = t$

$$\Rightarrow t^3 - \frac{3(t^2 - 1)t}{2} = 3t + 2$$

$$\Rightarrow 2t^2 = 3t^3 + 3t = 6t + 4$$

$$\Rightarrow t^3 + 3t + 4 = 0$$

$$\Rightarrow (t + 1)(t^2 - t + 4) = 4$$

↓

imaginary roots

$$\Rightarrow t = -1 \Rightarrow \sin x + \cos x = -1$$

$$\Rightarrow \sin 2x = 0$$

$$78) y = \frac{x^2 + ax + 1}{x^2 + x + 1}$$

$$x^2(y - 1) + x(y - a) + (y - 1) = 0$$

Case I : $y \neq 1, D \geq 0$

$$(y - a)^2 - 4(y - 1)^2 \geq 0$$

The above inequality cannot be satisfied for all real values of y whatever be the value of a.

$$A = 1 - 2\sin^2\alpha \cos^2\alpha = 1 - \frac{1}{2}\sin^2 2\alpha$$

$$\Rightarrow \text{For } \alpha \in \mathbf{R}, A \in \left[\frac{1}{2}, 1\right]$$

$$\text{Similarly } B = 1 - 3\sin^2\beta \cos^2\beta$$

$$= 1 - \frac{3}{4}\sin^2 2\beta$$

$$\Rightarrow \text{For } \beta \in \mathbf{R}, B \in \left[\frac{1}{4}, 1\right]$$

$$\text{Now } (A + 2B)_{\max} = 3 \quad \& \quad (2A - B)_{\min}$$

$$= \frac{3}{4}$$

$$80) \therefore [(A + 2B)_{\max}] + [(2A - B)_{\min}] = 3$$

$$\begin{aligned} 81) \prod_{i=0}^{10} (i+x)^{i+1} &= x(1+x)^2(2+x)^3 \dots (10+x)^{11} \\ &= x^{66} + (1.2 + 2.3 + 3.4 + \dots + 10.11)x^{65} + \dots \\ &\Rightarrow \text{coefficient } x^{65} = \sum_{n=1}^{10} n(n+1) \\ &= \sum_{n=1}^{10} n^2 + \sum_{n=1}^{10} n = 385 + 55 = 440 \end{aligned}$$

82)

For equilateral Δ

$$\sum z_1^2 = \sum z_1 z_2$$

$$(z_1 + z_2 + z_3)^2 = 2 \sum z_1 z_2$$

$$(3z)^2 = 3 \times 3\beta$$

$$\alpha^2 = \beta$$

$$83) (e^2 - 1)^2 = e^{2x} - 2e^x + 1$$

$$e^x = \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!}$$

$$e^{2x} = 1 + \frac{2x}{1!} + \frac{(2x)^2}{2!} + \frac{(2x)^3}{3!} + \frac{(2x)^4}{4!}$$

$$\text{co-efficient of } x^4 = \frac{2^4}{4!} - \frac{1}{4!} = \frac{7}{12}$$

$$84) A + C + B = 3B = 180^\circ$$

$$A + C = 120^\circ, B = 60^\circ \quad h = \ell(AB) - \ell(BC)$$

$$\begin{aligned}
&\Rightarrow h = \frac{h}{\sin A} - \frac{h}{\sin C} \\
&\Rightarrow \sin C - \frac{\sin A}{\sin C} = \sin A \cdot \frac{\sin C}{\sin C} \\
&\Rightarrow 2 \sin\left(\frac{C-A}{2}\right) \cos\left(\frac{C+A}{2}\right) \\
&= \frac{1}{2} \{ \cos(C-A) - \cos(C+A) \} \\
&\Rightarrow \sin\left(\frac{C-A}{2}\right) = \frac{1}{2} \left\{ 1 - 2\sin^2\left(\frac{C-A}{2}\right) \right\} + \frac{1}{4} \\
&\Rightarrow \sin^2\left(\frac{C-A}{2}\right) + \sin\left(\frac{C-A}{2}\right) - \frac{3}{4} = 0 \\
&\Rightarrow \sin\left(\frac{C-A}{2}\right) = \frac{1}{2}
\end{aligned}$$

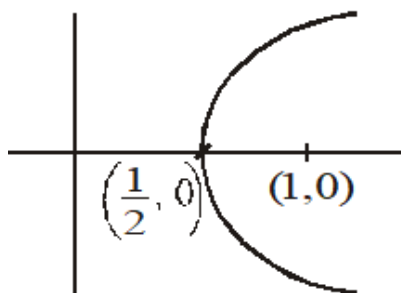
$$85) 2^5 3^7 5^3 7^2$$

$$86) \tan 9^\circ + \tan 81^\circ - \tan 27^\circ - \tan 63^\circ.$$

$$\begin{aligned}
&\tan 9^\circ + \cot 9^\circ - (\tan 27^\circ + \cot 27^\circ) \\
&= \frac{\sin^2 9^\circ + \cos^2 9^\circ}{\sin 9^\circ \cos 9^\circ} - \frac{\sin^2 27^\circ + \cos^2 27^\circ}{\sin 27^\circ \cos 27^\circ} \\
&= \frac{\sin 18^\circ}{2 \times 4} - \frac{\sin 54^\circ}{2 \times 4} \\
&= \frac{(\sqrt{5}-1)}{(\sqrt{5}-1)} - \frac{(\sqrt{5}+1)}{(\sqrt{5}+1)} = 4
\end{aligned}$$

$$\begin{aligned}
87) &\int e^{\cot x} (\cos x) dx \\
&= e^{\cot x} \sin x - \int (-\operatorname{cosec}^2 x) e^{\cot x} (\sin x) dx \\
&\Rightarrow \int e^{\cot x} \cos x dx = e^{\cot x} \sin x + \int (\operatorname{cosec} x) e^{\cot x} dx \\
&\Rightarrow \int e^{\cot x} (\cos x - \operatorname{cosec} x) dx = e^{\cot x} \sin x + C \\
&\Rightarrow f(x) = \cot x \text{ \& } g(x) = \sin x
\end{aligned}$$

$$\begin{aligned}
88) &\text{If } |z+1| > |z-1| \\
&\Rightarrow (x+1)^2 + y^2 > (x-1)^2 + y^2 \\
&\Rightarrow x > 0 \\
&\text{Then } \operatorname{Re}(z) = |z-1| \\
&x^2 = (x-1)^2 + y^2 \\
&y^2 + 1 = 2x \\
&\text{Similarly if } |z-1| > |z+1|
\end{aligned}$$



$$\text{then } y^2 + 1 = -2x$$

$$\therefore x > 0 \Rightarrow \text{No locus.}$$

$$\therefore \operatorname{Re}(x) \geq \frac{1}{2}$$

$$89) \int \sec 2x \, dx = \frac{1}{2} \log \left| \cot \left(\frac{\pi}{4} - x \right) \right| + c$$

$$\therefore g(x) = \cot \left(\frac{\pi}{4} - x \right)$$

$$\text{domain of } f(x) = \mathbb{R} - \{0\}$$

$$\text{range of } g(x) = \mathbb{R}$$

$$f'(x) = \frac{1}{2x} \quad \forall x \in \mathbb{R} - \{0\}$$

$$g'(x) = \operatorname{cosec}^2 \left(\frac{\pi}{4} - x \right) \cdot (-1) = \operatorname{cosec}^2 \left(\frac{\pi}{4} - x \right)$$

$$90) z^2 = w^2 \Rightarrow |z| = |w| \Rightarrow B \subset A$$

93) We have :

$$\begin{aligned} & \frac{1}{1^4} + \frac{1}{3^4} + \frac{1}{5^4} + \frac{1}{7^4} + \dots \\ &= \left(\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \frac{1}{4^4} + \frac{1}{5^4} + \frac{1}{6^4} + \frac{1}{7^4} + \dots \right) \\ & \quad - \left(\frac{1}{2^4} + \frac{1}{4^4} + \frac{1}{6^4} + \dots \right) \\ &= \frac{\pi^4}{90} - \frac{1}{16} \left(\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \dots \right) \\ &= \frac{\pi^4}{90} - \frac{1}{16} \left(\frac{\pi^4}{90} \right) = \frac{\pi^4}{96} \end{aligned}$$

$$94) \frac{4(1-a-b) - (a-b)^2}{4} > \frac{-(a+b)^2 + (1+a+b)}{(-4)}$$

$$\text{By solving } a^2 + b^2 < 4$$

$$95) D < 0$$

$$64(a+5)^2 + 4.16(79+5) < 0$$

$$a^2 + 25 + 10a + 7a + 5 < 0$$

$$a^2 + 17a + 30 < 0$$

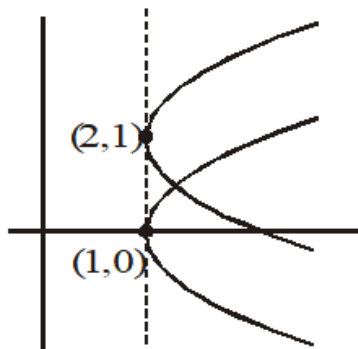
$$a \in (-15, -2)$$

$$n(s) = 20$$

$$n(\text{favourable}) = 13$$

$$\text{Probability} = \frac{13}{20}$$

$$96) y^2 = 4(x-1) \text{ and } (y-2)^2 = 8(x-1)$$



Common tangent of the two parabolas is the tangent at vertex to them.

∴ length of common tangent

= distance between the vertices = 2

97) For $0 < x < 1$

we know that $x^2 > x^3$ and for $1 < x < 2$

we have $x^3 > x^2$ thus $2^{x^2} > 2^{x^3}$

for $x \in (0, 1)$

and $2^{x^3} > 2^{x^2}$ for $x \in (1, 2)$

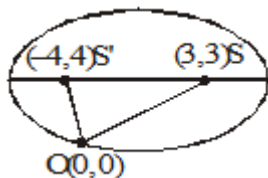
So, $I_1 > I_2$ and $I_3 > I_4$

98) Given is

$$ax + \sin^{-1}\{-1 - (x-2)^2\} + \cos^{-1}\{-1 - (x-2)^2\} = 0$$

$$\therefore -1 \leq -1 - (x-2)^2 \leq 1 \Rightarrow x = 2$$

$$\text{so, } 2a + \frac{\pi}{2} = 0 \Rightarrow a = -\frac{\pi}{4}$$



99)

Here S is (3, 3) & S' is (-4, 4).

$$\Rightarrow SS' = \sqrt{50} = 2ae \quad \dots (i)$$

$$\text{Now } OS + OS' = 2a$$

$$2\sqrt{2} + 4\sqrt{2} = 2a$$

$$7\sqrt{2} = 2a \quad \dots (ii)$$

From (i) & (ii)

$$e = \frac{5}{7}$$

$$\vec{r} \cdot \hat{n} = \frac{q}{|\vec{n}|}$$

100) Equation of plane is

for intercept on x-axis take dot product with $\hat{i}$

$$\Rightarrow \text{intercept on x-axis} = \frac{q}{\hat{i} \cdot \vec{n}}$$

101) Explanation: The sentence uses helping verb 'is' and the pronoun 'it' should be used to replace the noun 'party'. Therefore option C is correct.

102) Explanation: The verb 'proceed' means 'move forward'. An 's' can't be added to the root form of the verb if the sentence is not in simple present tense and the subject is not the third person. The verb 'cede' means 'give up the power'. Therefore options A, B and C are incorrect. The verb 'precede' means 'appear before in time or in order'. Therefore option D is correct.

103) Explanation: The phrasal verb 'come across' means 'meet or find by chance'. This word fits in the given sentence perfectly. Therefore option A is correct.

104) Explanation: The word 'Flagitious' is used to refer 'a person involved in crimes or wrong doings'. Therefore option C is correct.

105) Explanation: Hygrometer is used to measure humidity in the atmosphere, while anemometer is used to measure the speed of wind. Therefore option B is correct.

106) Explanation: A sentence written in present perfect tense when changed to passive voice follows the given structure: Obj. + has/ have+ been + verb3+ by+ sub. Therefore option C is correct.

107) Explanation: Option B is correct.

108) Explanation: Option C is correct.

109) Explanation: Option C is correct.

110) Explanation: Option A is correct

PART-IV(B) : Logical Reasoning

111) Explanation: The figure rotates 180 degree and arrow head get reversed.

112) Explanation: In the first figure,

$$8 = 4 \times 2, 7 = 1 \times 7, 8 = 8 \times 1.$$

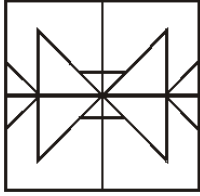
In the second figure,

$$4 = 2 \times 2, 9 = 3 \times 3, 6 = 6 \times 1.$$

So, the digits of the missing figure are

$$7 \times 1, 4 \times 1, 2 \times 4, \text{ i.e. } 748.$$

113) Explanation :



114) Explanation: In all others, the digit indicates the gap between the two letters.

116) Explanation: There are three different shapes rectangle, round and triangle, three directions of inside shape.

117) Explanation: D

We have : $AL = A + L^2 = 1 + 12^2 = 145$;

$CF = C + F^2 = 3 + 6^2 = 39$;

$CP = C + P^2 = 3 + (16)^2 = 259$;

$DJ = D + J^2 = 4 + (10)^2 = 104$

So, the missing numbers are

$GM = G + M^2 = 7 + (13)^2 = 7 + 169 = 176$

$LM = L + M^2 = 12 + (13)^2 = 12 + 169 = 181$.

119) Explanation: Clearly, the patterns followed by the letters are as follows:

1st letter : $Y \rightarrow W \rightarrow U \rightarrow S \rightarrow Q \rightarrow O$ (-2)

2nd letter: $A \rightarrow D \rightarrow G \rightarrow J \rightarrow M \rightarrow P$ (+3)

So, the series formed by the numerals i.e

1, 16, 49, 100, 169 follows the pattern

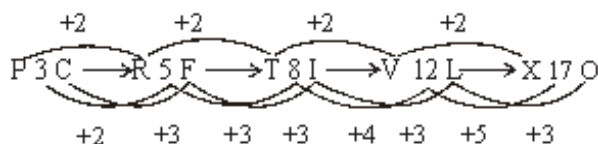
$A \rightarrow 12 = 1$, $D \rightarrow 42 = 16$, $G \rightarrow 72 = 49$,

$J \rightarrow 102 = 100$, $M = 132 = 169$, $P \rightarrow 256$.

So, numeral in the desired term =

Hence desired term is O256P.

120) Only in the first series, the image rotates 45 degrees as it moves towards the right side. In the second series, it turns 30 degrees; in third series, it rotates 90 degrees, and in the fourth series, it rotates by 15 degrees as it moves one step forward towards the right side. See the corner of the image, which forms a small square, to understand the movement of the image.



121)

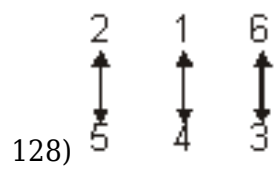
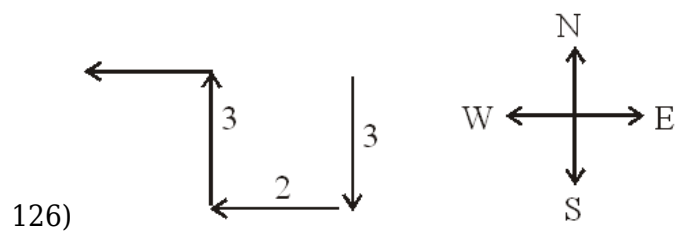
122) (Diagram)

∴ S – W

125) All figure rotated Clockwise

↑ & □ → Interchanged

○ & △ → Interchanged



2 opposite to 5

1 opposite to 4

6 opposite to 3

129) Number of parallelograms = 6

